

## HENRY COUNTY AND PORTIONS OF RANDOLPH, WAYNE AND DELAWARE.

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Henry County was named in honor of Patrick Henry, of Virginia. It was organized in 1822. It is situated in Central Eastern Indiana, and has for its northern boundary, Delaware County; for its western, Madison and Hancock; for its southern, Rush and Fayette; for its eastern, Randolph and Wayne counties. It has an area of about 400 square miles. Its principal towns are New Castle, the county seat, a thriving city of nearly 4,000 inhabitants; Knightstown, with a population of about 2,500, is favorably situated on Blue River, near the south line of the county. The smaller towns are Raysville, Middletown, Ogden, Louisville, Greensboro, Hillsboro, Blountsville, New Lisbon, Cadiz, Spiceland, Sulphur Springs, Mt. Summit and Mechanicsburg. All these are situated in rich agricultural localities, and are convenient trading points for the farming community adjoining, as well as furnishing pleasant homes for those who wish to retire from the more active duties of life. The streams of the county are Blue River, Fall Creek, Duck Creek, Flat Rock and Stony Creek. While none are large, yet they are utilized to a considerable extent for water-power. This county is well supplied with railroads, the Ft. Wayne, Muncie & Cincinnati, the Pittsburg, Cincinnati R. R., with its two divisions; the I., B. & W. and the southern extension of the Ft. Wayne, Muncie & Cincinnati R. R. to Louisville, Ky., give ample communication with all parts of the country, as well as furnishing abundant shipping points for the various agricultural products.

### EDUCATIONAL ADVANTAGES.

Indiana justly regards her public schools with pride, and Henry County ranks among the best in this respect, for not only is it well supplied with common schools, but the numerous high schools of the many villages, with the Academy at Spiceland, under the able direction of Prof. Pinkham, are doing good work. Prof. Harvey, Superintendent of the New Castle schools, is fully alive to the responsibility, and abundantly able to place the schools under his charge on an equal footing with those of the other cities of the State.

## TOPOGRAPHY.

Henry County is one of the most elevated in the State, ranking with Southern Randolph and Northern Wayne. The altitude of all three of these counties is due to the same cause. North of the center is a divide or water-shed, which passes through it with a direction a little north of east from the point where it enters the county near the south-west corner of Harrison Township. This ridge extends through Cadiz, the southern part of Jefferson and Prairie townships, and finally leaves the county in Stony Creek and Blue River townships, just north of the I., B. & W. R. R. Where this ridge enters the county on the west, it is but feebly marked, the surface there being quite level with only an occasional hill or low mound of gravel; two miles west of Cadiz the surface becomes quite rolling, and continues so until it enters Jefferson and the north-western portion of Henry Township, when it again becomes lost in the level plain with low scattering hills; this continues eastward to the valley of Blue River. At Cadiz the descent to the north is quite gradual, but more rapid to the south, so that its ridge-like character is quite marked. When viewed from the level plain to the south of it, it may be seen stretching to the north-east and south-west as a well-marked ridge, its summit being from thirty to forty feet above the adjacent plain. The rolling surface here extends from one-half to one mile northward from its southern border. Approaching it from the north one is hardly conscious that there is any rise in the surface, and he only fully realizes its character when from its southern edge he views the level plain to the south of and below it. People at Cadiz claim that this is the highest point in the county. It has a high elevation, but in the absence of a careful topographical survey it would be hazardous to designate it as the highest. East of Blue River the surface becomes rolling; its ridge-like character is not so distinctly marked, for the descent to the south is more gradual, while the high and rolling surface extends northward to the Delaware County line, over Prairie and Stony Creek townships. South of this high land the surface becomes quite level in Henry and Liberty townships. In the eastern portion of the county the water-shed does not follow the direct line pointed out at the beginning, but from a point near Mt. Summit it curves three or four miles northward, to the head waters of Buck Creek, Prairie Creek and Blue River, thence southward to the bowlder tract, near its point of exit from the county, on the line between Stony Creek and Blue River townships. However, the water-shed does not necessarily coincide with the elevations that are highest, for the channels now occupied by the streams flowing southward have been cut through this high ridge or table-land. Little Blue River mostly flows to the south of this high land, though its source is found near its summit. This divide, or elevated table-land, continues eastward through Randolph County into the State of

with the valley and about one mile from it. The formation of this peculiar tract bordering the river will be discussed under the head of "Glacial Rivers," to which they in great part owe their origin. Flat Rock Creek, in its upper portion, flows through a comparatively level surface, but as it approaches the south line of the county it becomes bordered by low, rounded hills or knolls. Nettle Creek rises to the north of Losantville, Randolph County, and its upper portion flows through a nearly level country. As soon, however, as its channel begins to cut its way through the high land to the south, its valley becomes bordered by high hills or rounded bluffs. West River and Martindale's Creek both rise on the very summit of the table-land and their valleys have been cut deep in passing through it to the south. From the above description it will be seen that this district is composed of a high table-land, gradually sloping to the north and south. That in the north it is bordered by a level plain which gradually becomes merged into the rolling surface so characteristic of this divide. On the south, the descent is more rapid and the rolling surface soon becomes lost in the level plain, except along Blue River, where the surface so common to this high land continues, and also between the streams flowing south, where long, parallel ridges extend nearly to the White Water River valley. The following table of altitudes will aid in the study of the surface configuration of this district:

TABLE OF ALTITUDES ALONG THE I., B. &amp; W. R. R.

	<i>Feet Above the Ocean.</i>
West line of Randolph County . . . . .	1,171.50
One-half mile south of Losantville . . . . .	1,140.60
Valley of Nettle Creek. . . . .	1,129.40
Summit between Nettle Creek and West River . . . . .	1,186.10
West River valley bridge . . . . .	1,120.00
Township line at Hoover's saw-mill. . . . .	1,220.00
Summit between Martindale Creek and Green's Fork . . . . .	1,234.40
Crossing of Richmond, Ft. Wayne R. R., near Lynn . . . . .	1,173.80
Lynn Station . . . . .	1,183.00
Summit on line between Washington and Green's Fork townships . . . . .	1,187.50
Summit west of boundary road. . . . .	1,220.00
Divide of drainage between Noland's Fork and Greenville Creek . . . . .	1,186.00
Summit between Noland's Fork and the east fork of White Water . . . . .	1,214.60
State line, one mile north of the southeast corner of the county . . . . .	1,180.44
East of the last-named point the descent is gradual to the Miami valley.	

## FT. WAYNE, RICHMOND &amp; CINCINNATI R. R.

Summit between Salamonie and Mississinewa rivers (ground), Jay County.	1,053.00
Ridgeville railroad crossings, Randolph County . . . . .	993.00
Summit between Mississinewa and White rivers . . . . .	1,095.00
Low water of White River near Winchester . . . . .	1,053.00
Winchester, at the crossing of the Bee Line Railroad . . . . .	1,088.00

*Feet Above the Ocean.*

Summit between White River and Green's Fork of White Water . . . . .	1,188.00
Low water of Green's Fork of White Water . . . . .	1,111.00
Summit between Green's Fork and Noland's Fork of White Water, about two-thirds of a mile south of Wayne County line . . . . .	1,212.00
Low water of Noland's Fork of White Water . . . . .	1,062.00
Summit between Noland's Fork and White Water . . . . .	1,132.00
Richmond City (track at passenger depot) . . . . .	969.00
Ft. Wayne, Muncie & Cincinnati R. R., Muncie station . . . . .	948.00
Track at Henry County line . . . . .	1,016.00
Track at Springport . . . . .	829.00
Track at summit between White and Blue rivers . . . . .	1,107.00
Track at New Castle, on Blue River . . . . .	1,045.00
Track at New Lisbon . . . . .	1,109.00
Track at Wayne County line . . . . .	1,056.00
Track at Cambridge City . . . . .	957.00

## P., C. &amp; ST. L. R. R.

Ohio and Indiana State line . . . . .	1,026.00
Richmond . . . . .	972.00
Track at Centerville . . . . .	1,008.00
Summit west of Centerville . . . . .	1,084.00
Cambridge City . . . . .	949.00
Track at Dublin . . . . .	1,066.00
Summit east of Lewisville . . . . .	1,143.00
Track at Knightstown . . . . .	916.00
Hagerstown . . . . .	1,003.00
Surface of high table-land, source of Flat Rock Creek, near line between Henry and Randolph counties . . . . .	1,128.00

## WATER.

This region is remarkably well supplied with this wholesome beverage. The numerous small streams with the many springs found everywhere throughout the rolling surface or along the streams furnish an abundance for man and beast. Where not thus supplied, water can usually be obtained at depths varying from twenty to thirty feet. In northern Prairie Township wells are frequently sunk from forty to sixty feet before the water-bearing gravel is reached. As usual throughout the Drift region, the gravel is overlaid by the gray and yellow clays, the blue boulder clay never being reached. In the valleys very little clay is found and water is usually reached at a depth of ten or fifteen feet. The fall of many of the streams is so rapid that they are utilized for water power during a portion of the year.

## PALEOZOIC GEOLOGY.

About three miles south-west of Greensboro, at the Quarry Mills on Blue River, is the only outcrop of rock found or heard of in Henry County. This was at one time quite extensively quarried. At present the pits are all filled with water, and the only chance for observing the character of the rock was found in the fragments lying about and in the foundation of the mill. The thickness of the strata varied from one inch to one foot. The upper strata are of a buff color gradually changing to a gray or drab in the deeper layers. Just below the bridge is an exposure of about four feet of a bluish shale overlying the quarry layers. This shale rapidly disintegrates upon exposure to the air and changes to a yellowish color, due to the oxidation of the iron contained in it. This stone used for the foundation of the mill gives every evidence of durability. It also made fair lime. No fossils were found here except the cast of a valve of *Atrypa reticularis* and a poorly preserved cast of a *Zaphrentis*, probably *Z. celator*. In the clay shale were found a few casts of a fucoid. While the paleontological evidence is not sufficient to determine its horizon, yet its lithological characteristics place it at once in the Niagara group, and probably in the Guelph division, as the rock resembles that east of Muncie, which has been determined as belonging to that portion of the Niagara. Although diligent inquiry was made, we were unable to learn that any fossils had ever been found at this locality. The State geological map represents Henry County as having its southwestern portion covered with Devonian rocks. This may be true, but in the absence of any exposure it is at best a mere conjecture. There are in the county quite a number of good collections of fossils, mostly, however, from other localities, as here even the Drift is quite barren of fossils. We had the pleasure of examining the collection at Spiceland Academy; this is quite well supplied with Lower and Upper Silurian forms, and, when classified, will add much to the facility for teaching this interesting study at this institution. Prof. Harvey and Mrs. Dr. Boor, of New Castle, also have fine collections.

## THE DRIFT.

This deposit or formation covers the whole county, and presents the usual characteristics of this deposit as found in Randolph and Delaware counties to the north. The blue boulder clay was observed at only one point—just east of the rock exposure at the Valley Mills. Its upper portion only was seen and the thickness could not be determined. The Drift over portions of this district must be in places at least two hundred and fifty feet thick, perhaps more; at other localities probably not over

fifty feet. This, of course, is mere conjecture, as no section could be obtained. The deepest wells do not reach the bowlder clay, and natural sections give only a few feet of the upper portion. The surface clays are either yellow, where thoroughly oxidized, or gray where they have not been so affected; beneath the surface they are of a bluish or gray color. The first water-bearing gravel is usually reached at depths varying from ten to sixty feet.

#### GLACIAL RIVER CHANNELS.

These outlets for the water of the melting glaciers have played a prominent part in the surface configuration, and have helped to give variety to the topographical features of the district. Fall Creek now occupies a broad valley, bordered by rounded hills, not, properly speaking, bluffs, though usually so called. The creek seems totally inadequate for the accomplishment of such phenomena as is here presented. High hills of sand and gravel border it on both sides, and extend back from one-fourth to one mile. The hills are not steep, but have gentle waving contours, and, as is usually the case along all these channels, are highest a little distance from the valley, with a gradual descent to the adjacent plain as well as to the bluffs immediately adjoining the valley. This channel continues north-east into Delaware County, where it is known as the "Glade," a long swampy tract, which extends to within about four miles of Muncie, and it is probable that it is a continuation of the channel that passes through where the city now stands. This stream had its source in the north-eastern part of Delaware County, where a temporary advance of the glacier piled up material enough to act as a dam to the waters flowing from the north and east, probably forming a lake extending east from the ridge at Black's mills to Albany and south, with a curve to the west to Selma. This lake furnished water for two or three very prominent glacial rivers; at least they can all be traced to this locality. This stream broke through the morainic *debris*, just south of Black's mills, and pursued an almost direct south-westerly course to Muncie, south of which it can be followed by the kames, or hills of gravel. Although the glade previously mentioned is a little west of the line of this channel, they were once probably united. It is a characteristic feature of all these channels to be obscured throughout a portion of their course. Once given their general direction they can usually be traced by means of the gravel hills or the black soil, although the channel or valley may be obliterated. Near the sources of Fall and Bell creeks, in Delaware County, are a number of long swampy tracts, now occupied by these streams and their tributaries, which are evidence that at one time overflows from this stream found an outlet in different directions through these valleys. Beginning just west of Selma, Delaware County, in the level prairie, which we have considered as having once been a lake, is the source of the main stream which passed through

Henry and Delaware counties. The occurrence of sinks in the bed of the L. E. & W. Railroad indicates that it might have been still further north, but at present this will be considered its starting point until further investigations enable its course northward to be indicated. All these channels are partially silted up with sand, gravel and clay. Just west of Selma, where crossed by the Bee Line Railroad, it was deep enough and treacherous enough to swallow up their embankment when first built. This channel extends south-westward across the valley of White River, and to the east of New Burlington, into Henry County. Near the county line, the channel, now called prairie, is filled up sufficiently to cause the water of Prairie Creek to flow northward to White River. The valley of Buck Creek extends directly across this prairie a little south of this point. The old channel, however, continues on through a gap in the hills, and what is now called the prairie can be traced to the valley of Blue River, which follows the valley excavated by the stream which long since ceased to flow. One must bear in mind, when considering this broad valley and the rounded hills of sand and gravel which reach from fifty to one hundred and fifty feet above it, that they were not formed by the insignificant stream which now meanders through it, but by one whose source of supply was a great sheet of melting ice. The valley was full to the brim with large blocks of ice filled with sand, gravel and bowlders, floating on its bosom or being piled up on either side, to be reassorted again and again to form the rounded hills. It was a torrent, gathering in the streams from every side, on its way to join the "Collett Glacial River." This I consider one of the main streams that helped to form that mighty, but short lived river, which probably surpassed the Ohio or Mississippi of to-day. Dr. Elrod, in his report on Bartholomew County, estimates its width at forty miles (see page 165 report for 1881), but this of course is an exaggeration, and is only true of the lobe of the glacier which once occupied this valley. It is not probable that the river proper was more than two or three miles wide. This stream, in Henry County, overflowed its banks in places and excavated valleys, now called prairies, which at present are not occupied by any streams. One such is found just east of Mt. Summit; another overflow north-west of New Castle was largely instrumental in forming the valley of Duck Creek. The excavation left the flat-iron shaped table-land which extends from the source of the creek to below Greensboro, where it joined the main stream. With a rapid stream on each side, the southern point of this tract was extended as a ridge of gravel and sand far to the southward, forming a veritable *âsar*. This narrow ridge was continued beyond the confluence of the creek with the river, but at a lower level, being here situated on the terrace about thirty feet above the river. It is here composed almost entirely of gravel. This terrace is principally found on the west side of the river. Greensboro and Knightstown are both situated on it. Near Selma the banks of this

channel are quite low, but gain in height and interest to the south line of Henry County. In Drake County, Ohio, is a long swampy tract which can be traced to Greenville Creek and Noland's Fork. It passes a little east of Union City, and it is probable that it is the source of supply for their water works. This was evidently a stream of considerable size, for its valley, where it crosses the table-land, is wide and deep. Overflows from this probably excavated the valley now occupied by Green's Fork. Another overflow occurred in Ohio, just east of the north-east corner of Randolph County. This passed west along the southern border of what is known in Jay County as the "Lost Mountain" to Ridgeville, just west of which it turns to the south and probably found an outlet across the divide through the valley of West River. Martindale's and Nettle creek valleys both served as outlets for temporary streams from the edge of the ice sheet. It is safe to say that all the streams now flowing south from this divide have had their valleys excavated to a great extent by the glacial waters, though the present streams may have contributed something in that direction. Another of these streams entered Delaware County from the north and flowed in a south-westerly direction down the valley now occupied by Estey Creek. This crossed the valley of the Mississinewa River about two miles east of Eaton. South of the river it can not be traced, but a portion of it may have turned to the east and joined the stream first described, which continues through Delaware County to the valley of Fall Creek, or, what is more probable, it all flowed down the valley of Kil Buck, and was instrumental in forming the prairie with the hills of sand and gravel that are mentioned by Dr. Brown in his report of Madison County, as extending from Anderson to near Pendleton.

## KAMES.

These are rounded hills or elongated ridges terminating abruptly in a high mound or at times with the mounds nearly midway and a gradual slope to the level plain adjacent, or again conical mounds or hills arising abruptly from the level surface, isolated or in groups. All these are composed of gravel and sand, and where clay is present it forms the nucleus around which the other materials have gathered, and as a rule it shows no stratification; the gravel and sand, however, in their stratification show that they were deposited by currents having considerable power as well as coming from different directions. One portion of the mounds will show fine sand, while another will present a bed of boulders from three inches in diameter up to one foot or even more. It is characteristic of this variety of the kame type of deposits that they all have their long or major axis transverse to either the ice flow or the direction of the lines of drainage from the ice sheet. Most of those observed extended from north-west to south-east; however, a few showed a direction from north-east to south-



west. They vary in height from twenty to fifty or sixty feet, and at the base are from ten to thirty rods wide. Most of those met with are adjacent to some of the ancient channels just described, being found from one-fourth to one-half mile distant. As they are built up almost entirely above the level of the general surface of the ground; they are evidently among the latest of the Drift deposits, probably not deposited until after the greater thickness of the Drift sheet had been laid down. Between Muncie and Granville, west of the Granville pike, are three of these mounds, the one south of Granville being the highest. Another is found in the city of Muncie; West Charles Street was cut through its northern extremity. Dr. Winton's residence is built on another, south-east of this one. South of the city and east of the old channel is one which has furnished a large amount of gravel; west of the channel are found one or two others. Between Muncie and Smithfield are two more, situated south of the pike and about one mile west of the main channel; these are the most marked and important ones in Delaware County, though a few smaller ones are found in Monroe Township. It is remarkable that none are found in either the eastern or western portions of the county. This peculiar type of Drift is evidently closely connected with the ancient line of drainage, but just how the currents of running water have acted is not definitely understood. It is probable that at the time of their formation the surface was covered with ice, though it may not have been one continuous sheet, but broken by currents of water flowing toward the main channel of drainage, through the breaks or gaps in its surface. It is hardly probable that the ice sheet in its many temporary advances and retreats always presented a bold precipitous face to the south. More likely that there were large pieces or masses detached from the main body giving rise to lateral streams flowing through the depressions between them. Any currents of water sufficiently deep to reach their summit to-day would submerge a large portion of the country, and one is loath to believe that the whole country was covered with water; at least, there is no evidence that such was the case. However, admitting that to have been true, it is difficult to understand how currents from the north-west or south-east could have been produced sufficiently powerful to move the boulders. None of this variety of kame type was observed either in Randolph or Wayne counties, and but few in Henry County, and they were closely related to the form of kame type found bordering the Glacial river channels that they have been considered as due to the same cause. It will be seen from the above description of this form of Drift formation that I have divided the kames into two varieties: First, those having been built up almost entirely above the general surface of the ground, and having their long axis transverse to the direction of the ice flow or lines of drainage; second, those immediately adjacent to the lines of drainage and having their summits but little, if at all, elevated above the general sur-

face adjoining. While both these classes of kames are the result of fluvial actions, the peculiar conditions under which each were formed, were probably very different. Of the second variety good examples may be found bordering Blue River and Fall Creek. The following description of the kame type by Professor Geikie will give a good idea of the phenomena observed: "The sands and gravels have a tendency to shape themselves into mounds and winding ridges, which give a hummocky and rapidly undulating outline to the ground. Indeed, so characteristic is this appearance, that by it alone we are often able to mark out the boundary of the deposits with as much precision as we could were all vegetation and soil stripped away and the various subsoils laid bare. Occasionally ridges may be traced continuously for several miles across the country, like great artificial ramparts. It is most common, however, to find mounds and ridges confusedly intermingled, crossing and recrossing each other at all angles, so as to enclose deep hollows and deep pits between. Seen from some dominant point, such an assemblage of kames, as they are called, look like a tumbled sea, the ground now swelling into long undulations, now rising suddenly into beautiful peaks and cones, and anon curving up in sharp ridges, that often wheel suddenly round so as to enclose a lakelet of bright, clear water." The lakelets, however, are absent from this locality, as the hollows or pits are nearly all connected with the river. From the high hills south of Greensboro one can verify the above description. The old channel at this point turns to the west, and here we find the phenomena, described above, on the grandest scale. From the summit of the highest peak south of the river one can see the rounded hills, bordering the valley on both sides, for miles. Back from the valley the ridges become more numerous, while the mounds or hills are lower. So extensive is this tract (nearly three miles wide) east of the river at this point that I was at first inclined to consider it a portion of a moraine, and such a view may be correct with reference at least to the outer portion of this tract. Careful observation showed that the rounded hills immediately adjacent to the river were composed almost entirely of gravel and sand, showing that they have been reassorted again and again and the clay washed away. Back from the river they contain more clay. It is probable that all the hills adjoining the valley have been built up of material brought down by the old river. The waving contours have in part, at least, been produced by the lateral streams and rills. West of Blue River long ridges parallel with the valley predominate; these do not show that their materials have been reassorted, but evidently lie as deposited. It is probable that south from New Castle we have a portion of the moraine, presently to be described, modified by the Glacial river which found a passage-way through it. As all the other well-defined channels present similar phenomena, it is probable that their configuration is almost wholly due to fluvial action.

## ÅSARS.

These are long, narrow ridges of sand and gravel, which are parallel with the ice movement or lines of drainage; in fact, all observed in this district are found either in the valley or bordering them. East of Black's mills, west of Albany, in Delaware County, at the southern edge of a remarkable deposit of morainic *debris*, is a round ridge, with its summit high above the general surface adjacent. At this point it is mostly clay, but soon becomes composed of sand and gravel when followed southwest to the locality where the Mississinewa River has cut through it. At this point the high ridge of clay turns to the south, while the true åsar begins here and extends south-westerly for about two miles. It is bordered on the east by the valley of the glacial stream, while on the west the level plain stretches as far as the eye can reach. It terminates abruptly as though cut off by a transverse current. Its elevation is about thirty feet above the general surface, though not so high as the clay ridge east of it. Large numbers of the Niagara limestone boulders were observed at its base, near the river. South from the termination of this ridge is another, lower and shorter, situated about in the middle of the old channel. The clay ridge previously mentioned as turning to the south, when followed for about two miles takes on all the characteristics of an åsar. This was also terminated abruptly by a lateral stream which joined the main channel from the east. The change in the character of this ridge, when followed south, is evidently due to its situation between the two streams. The southern extremity of the clay ridge formed a breakwater like the abutment of a bridge, south of which the gravel and sand accumulated; this extended the ridge southward until the stream from the east joined the one on the west. About one-fourth mile south of the termination of this ridge is a high mound, abruptly sloping to the north, east and west, but soon becoming lost in the level surface adjacent when followed southward as it rapidly becomes lower in that direction. This would indicate that this was the southern terminus of the ridge just described, and the stream cut across it after it was formed instead of terminating it by turning abruptly to the west. The high, narrow ridge forming the southern extremity of the flat-iron-shaped table-land between New Castle and Greensboro was probably formed in a similar manner by the main stream on the east, and an overflow on the west, down the valley of Duck Creek. Near the confluence of Duck Creek with Blue River is a narrow ridge of gravel situated on the terrace which skirts the old valley on the west. It has no great length, but is quite marked and a veritable åsar. In the above descriptions of the kames and åsars, only those have been included that are evidently formed through the agency of running water. Under the description of the glacial moraine will be found others topographically similar, but structurally different.

## THE TERMINAL MORaine OF THE SECOND GLACIAL EPOCH?

We have placed a question mark after the above in deference to the State Geologist, who desires that nothing positive shall be asserted concerning its occurrence in Indiana until it shall have been given further study throughout the State. This deposit has been the especial study of Prof. T. C. Chamberlain, of the United States Geological Survey, who has traced its course from Indiana west through Michigan, Illinois, Wisconsin, Minnesota and Dakota. Eastward, Professors Wright, Lewis and Cook have extended their observations to the Atlantic coast, and at present we are compelled either to accept their conclusions or to question the accuracy of those eminent geologists. With deference to the opinions of others the writer believes that if the phenomena to be described as a moraine is not such, then there are none anywhere in Indiana. The extreme southern limit of the Drift is from fifty to one hundred miles south of this moraine, so that this formation must be considered as marking the southern limit of a temporary advance in the ice sheet, after it had retreated some distance northward of this deposit. It indicates that after the period of glaciation the cold was considerably moderated, the ice retreated far to the north—how far would be mere conjecture—but again advanced as the climate became more frigid. No doubt there were many temporary advances and retreats of the glacier before its final disappearance, but this one is so marked and extensive, reaching nearly three-fourths across the continent, that it indicates a great change in the climatic conditions during the Glacial Epoch. Hence the importance of giving careful study to this formation. The formation under consideration consists of an extensive belt of peculiarly ridged Drift. It constitutes a broad, irregular range of confusedly heaped Drift, rather than a simple, continuous ridge, or group of definite parallel ridges. "Genetically considered it embraces two or more such ranges which sometimes coalesce into a common, massive belt, and sometimes separate so as to reveal their distinct individuality and to occupy a width of twenty or thirty miles. The individual ranges in such instances are from one to six miles or even more in breadth, and embrace in themselves, on a small scale, the same confusion and complexity of structure that is presented by the united whole." This formation enters Indiana from the east, in southern Randolph and northern Wayne counties. It is here from six to eight miles wide and is better characterized as a high table-land than a ridge; the latter character, however, is clearly indicated, as it forms the watershed between White and White Water rivers. So gradual is the slope on either side that it is impossible to mark the limit of the formation with any degree of accuracy. Approaching it from the north, one is hardly conscious that he is nearing the highest land in the State, so gradual is

the ascent. The southern slope has a more rapid descent than the northern. The water-shed in Randolph County is from two to four miles from its south line; it does not coincide with the divide, or highest land, which lies from one to two miles south of it. The streams flowing southward follow depressions that were produced by the drainage from the glacier. The surface near the summit is quite level or gently rolling and this characteristic is observed through the county to near Losantville. The northern slope is more rolling. South from Spartansburg and Lynn, there are a number of hills, or kames, twenty-five to fifty feet in height, while along the streams the surface has been carved into rounded hills by the glacial streams. These hills are universally of clay, and have nothing in common, except shape, with the kames. While this was evidently deposited as a table-land, it to-day is composed of parallel ridges extending north and south between the streams. This is due, however, to the erosion it has suffered from the flowing water. Spartansburg is situated on the narrowest of these ridges. The glacial river passed to the east, and its old valley, now called a prairie, stretches as far as the eye can reach, north and south. In the south-eastern part of Nettle Creek Township and the south-western part of West River Township, a portion of this ridge or moraine turns to the south and enters Wayne County in Dalton and Perry townships, its western border here being very marked for five or six miles, when it gradually becomes lower, and finally, when traced southward to near Dublin, its ridge-like characteristics become lost in a broad table-land with a rolling surface interspersed with numerous low, winding ridges. This moraine, at Dalton, must be at least two hundred feet above the valley of Nettle Creek, and on its summit was seen a number of kame-like mounds and ridges which show evidence of having been subjected to currents of water during their deposition. They resemble those already described near Greensboro. The swell and sag topography is quite marked after it makes the turn to the south. Its eastern limit can not be accurately determined as it becomes lost in the southern slope of that portion of the moraine which extends south from eastern Randolph County. Prof. Chamberlain, in describing this moraine, after following it to the south-western portion of Wayne County, makes no mention of anything else in this district having any relation to it except the boulder tract. He has evidently overlooked a very interesting and important part of it, for a portion of it continues in a south-westerly direction through Henry County. At Losantville it is about one-half a mile wide and its ridge-like character is quite well marked. At this point it is easily seen to be a continuation of the northern portion of the moraine to the east. After entering Henry County it rapidly becomes wider, its northern border sweeping northward to near the south line of Delaware County, thence westward to the east line of Jefferson Township, where it gradually merges into the level plain. The southern border can be traced,

as a well-marked ridge, nearly to the west line of the county, in Harrison Township. Where this deposit is crossed by the valley of Blue River its character is obscured in the phenomena produced by the glacial river, and all traces are lost for four or five miles. About two miles east of Cadiz it begins to show itself again as a ridge, which increases in height to Cadiz, when it soon begins to decline when followed west. The surface is everywhere marked by the peculiar swell and sag topography, so characteristic of this formation. The swells are composed largely of clay. So monotonous does this peculiar surface configuration become that one is puzzled what to note as peculiar, and a single description will answer for all that portion east of Jefferson Township. Hill follows hill in rapid succession, or long narrow ridges intercept each other at all angles, and abruptly terminate in a rounded mound or gradually merge into the level surface. The ridges extend in every direction, but the larger ones show a tendency to coincide with the glacial movement. This variety of the kame type has evidently not been reassorted, but lies to day as deposited by the glacier. Throughout this district wherever this moraine is transverse to the ice flow, clay predominates, but whenever a portion turns southward the mounds, hills and ridges become filled with sand and gravel; this was especially noted east of Dalton, Wayne County, and it may be that the phenomena described previously, as occurring along Blue River, is in part at least due to the extension southward of a portion of this moraine down a pre-glacial valley, as it is parallel with that portion of the moraine to the east. At Cadiz the ridge is quite well marked; the descent to the north is quite gradual but to the south quite abrupt. The summit is here quite rolling. Westward it gradually becomes lower, but it probably forms the water-shed between White River and its east fork through Hancock and Marion counties. That such a water-shed exists can easily be seen by referring to any good State map. Immediately connected with this moraine is an accumulation of Drift in Delaware County that marks another temporary advance in the ice sheet. Rev. D. S. McCaslin, in his report of a geological survey of Jay County, describes what is evidently a local moraine, there called "Lost Mountain." This continues westward through Blackford into Grant County, where it forms the hills west of Walnut Creek. The accumulation in Delaware County is possibly a part of that in Jay. East from Eaton about two miles is a high ridge with the Mississinewa River to the south and the valley of Estey Creek on the north. This continues eastward nearly to Albany, becoming wider and lower in that direction, and with more gentle slopes to the north and south. A little north-west from Albany its southern border is distinctly marked as a ridge facing the level plain to the south. This extends westward about two miles when it turns to the south and extends to the Mississinewa River at Black's mills, west of Albany. It is here from twenty to fifty feet above the adjacent plain and the descent to it is

everywhere abrupt. North-east of Granville this ridge in its southern extension begins to narrow, and at this point we have a veritable "Kettle Moraine." Numerous rounded hills and ridges enclose shallow lakelets without outlets. This tract gradually narrows until it becomes a single narrow ridge, elevated from fifty to seventy-five feet, perhaps more, above the general surface east or west of it. South of the Mississinewa River it becomes higher and wider, but when followed south gradually becomes lower and more marked as a single ridge of sand and gravel. Just south of the Mississinewa River the old glacial river has reassorted the material of this ridge, making two short ridges. South of Muncie Creek this ridge turns to the east and, with a curve, to the west it extends to Selma, where it is lost in the high land bordering the old channel. It is possible that it curves to the east and forms the water-shed north of Winchester in Randolph County. Intimately connected with this moraine *debris* is a line of bowlders which extends along its southern border from Black's mills west to below Eaton.

#### THE BOWLDER TRACT.

From the description just given of the terminal moraine it will be seen that in this district it is composed of two ridges or Drift accumulations, which are united in Randolph County, that the main body turns to the south, while the northern portion continues on through Henry, and probably through Hancock and Marion into Johnson County, where it joins the main portion again. This last inference is legitimate, because the water-shed of Henry County produced by it can be seen to extend through these counties. Prof. T. C. Chamberlin, in describing this moraine, called attention to the boulder tract, which he considers as lying along its inner border. This is evidently a mistake, due to the fact that he did not recognize its true character at this point. It does not lie along the inner border of the outer ridge, but along the outer border of the north or inner ridge, except near Cadiz, where the bowlders are found north of the inner ridge. This is evident from the fact that it does not follow the main body in its curve to the south, but continues directly on through Henry County. This tract enters Henry County from the west in Harrison Township, and follows the southern edge of the divide or high land to Losantville. East of this place the ridge can not be separated, but the boulder tract continues on with the same general direction. East of Losantville it makes a slight curve to the south and then continues almost directly east to the State line. This tract is about one-fourth of a mile wide in the western part of the county, but it gradually widens eastward to Randolph County, where it is from one-half to one mile in width, its southern border reaching nearly to the Wayne County line. The bowlders are scattered irregularly over its surface, being at one point thick-

east along its northern border, a few miles away along its southern edge, then again in the center of the tract. In size they range from the smallest that are considered as bowlders to blocks five to eight feet long, by two or three in width; this last size is quite common. Six miles east of Mt. Summit is one of the largest I have ever met in Indiana; it is a gray granite, cubical in shape with the sides measuring about ten feet, with five feet exposed above the ground. A short distance east along the roadside were a number nearly as large, in some places they were formerly so thick that a number of farmers told me that they had hauled from two hundred to one thousand loads from their fields. In the absence of any quarries they have been utilized for foundations, fences, wells, etc. A few limestones were observed, but they are mostly azoic rocks, such as granites, syenite granites, biotite granites, quartzites, mica chists, felsites, and occasionally hornblendic gneiss, greenstones and conglomerates with quartz pebbles. Many of the granites were traversed by veins of feldspar, which have resisted weathering better than the matrix. Such specimens present a peculiar appearance that never fails to attract the attention of the farmers. The conglomerates are generally silicious, very hard and of a greenish white color. The I., B. & W. Railroad crosses this tract just west of Losantville. Arba is situated in this tract. Bowlders are quite common all over Eastern Indiana, but no where have we ever seen them thicker than along portions of this tract. Just north of Mt. Summit they are very plentiful, and I was told that they continued so for about one mile to the east. In Wayne County they are quite numerous along all the streams, and especially so just north of Fountain City along Noland's Fork. Prof. E. T. Cox, in his report of a survey of Wayne County, speaks of the numerous erratic rocks "along the shores of West Fork above the falls." He refers to them as a lateral moraine. He also considers the dividing ridges on the line of both his sections as marking the shores of a lateral moraine. I can not assent to this, for the ridges he mentioned as extending from the north line of the county, southward between the streams, are only remnants of the level plain south of the morainic ridge. Its present configuration is due to the erosion it has suffered from the many streams flowing southward from the edge of the glacier. The numerous bowlders along the valley, were many of them probably dropped from the blocks of ice that were carried down the channels, while many have been exposed by the washing away of the clay that once covered them, as bowlders are scattered plentifully throughout nearly the whole thickness of the Drift. Near all the outcrops of limestone in Eastern Indiana one will find numerous erratic rocks that have been torn from the glacier as it passed over the rocky barrier, and to such I would be inclined to refer the accumulation of bowlders at the falls of West Fork, rather than to a hypothetical lateral moraine. Prof. Orton, in the Geological Report of Ohio, Vol. III, gives the following description



of this boulder tract in Preble County, which joins Wayne County on the east. This tract curves to the south after entering Preble County: "A very remarkable boulder belt traverses its central and eastern regions—more remarkable than any similar belt thus far reported in the State. There are various points in this region where boulders are very thickly strewn over the surface for limited areas, as, for instance, along the uplands that bound the great Miami valley for twenty-five miles above Dayton, on the west side of the valley directly opposite Dayton and also in the country that lies west of Stillwater, in the vicinity of Union, Montgomery County. But none of these belts attain the proportions of that now under consideration. Its northern boundary is not distinctively defined, but there is a gradual thickening of the boulders until we find them in the central part of Washington Township so numerous as to render tillage of the fields difficult. From this point the belt can be followed in a broad band to the southward as far as the county line, and even beyond. Its length within the county will thus be seen to be at least ten miles. Its greatest breadth does not exceed three miles, but the east and west roads of the county cut across it diagonally so as to show sections four or five miles in breadth. The boulders range in size from one thousand cubic feet downward. Of one hundred and two blocks that were lying on the surface within a small compass the greatest length in any boulder was seven feet. A second gave a measure of five feet, four exceeded four feet, six exceeded three feet, thirty-five measured more than two feet, while the balance (fifty-five) were under two feet, none being counted that were less than one foot. It is probable that within the same area there were nearly as many more concealed by a shallow covering of soil. On a farm near West Alexandria 1,200 boulders exceeding two feet in diameter were counted to the acre. There are points where they are certainly more numerous than this. The boulders lie upon or very near the surface. Numerous sections of the Drift beds in this district are furnished in the banks of the streams and in artificial cuttings, but they do not show any unusual number of these blocks at any great depth. In their distribution they are irrespective of the elevations and irregularities of the surface. They cover the high ground and the low impartially." This boulder belt from its eastern point in Preble County, Ohio, has now been traced for a distance of about seventy-five miles as one continuous tract to the west line of Henry County. Throughout this whole distance they are thickly strewed, though, owing to the fact that the farmers have cleared their fields of them over most of the belt, they do not lie as thick as in Preble County, Ohio. Six miles east of Mt. Summit where the road crosses this belt they are not only very large but exceedingly numerous, as they are just east of Blue River and west of Losantville. A letter just received from Dr. R. T. Brown, who has made a survey of Hancock and Marion counties, states that the

boulder belt continues through Hancock and Marion into Johnson County, thus corroborating my predictions. The belt does not follow the watershed, but lies to the south of it. The watershed is produced by the main body of the morainic mass. Interesting conclusions necessarily follow the discovery of this northern morainic belt as distinct from the one marking the southern terminus of the glacial lobe, which filled the broad valley of the "Collett Glacial River," "Collett's Lobe," Prof. Chamberlin designates it. The distance between the two morains would render it probable that they should be considered separate formations rather than parts of a single moraine. The persistence of the boulder belt along the inner ridge, and their marked divergence from the main mass in Randolph County, indicate that they are due to another advance in the glacier, independent of and of later date than the one that filled the valley southward as far as Jennings County. The altitude of both Randolph and Henry counties is due to the coalescence of these two morainic masses, though probably in part to the Cincinnati Anticlinal Axis. The theory that the boulders were transported to their present position by icebergs will probably have to be abandoned, as all the evidence at present indicates that they were carried by the glacial ice and left behind in its retreat.

#### ARCHÆOLOGY.

One and one-half miles south-east of New Castle, on the farm of Mr. Bundy, was a circular enclosure about one hundred feet in diameter. The walls were about four feet high, with a shallow ditch inside. At present the whole has been nearly obliterated by the plow. No implements have ever been found here.

The following, taken from Elwood Plea's History of Henry County, gives a good description of the old fort, as it was formerly called. This is at present but feebly marked, and within a few years will probably be wholly obliterated. It is situated one and one-half miles north-east of New Castle, near the New Castle and Muncie Turnpike:

"The most remarkable mounds in the county are those on the Huddleson farm. They are, most of them, circular, with a ditch inside five or six feet deep. Several of them enclose nearly one-half acre each and generally have a mound in the center, the largest of which was about two rods in diameter and five feet high. A few of these enclosures were rectangular, and a few others irregular in form. Some of the walls were probably eight feet high in early times, and it is reported that some were surmounted by a stockade, the remains of which were easily seen by the earlier settlers less than fifty years ago."

In section 2, Henry Township, just south of Little Blue River, are a number of small mounds or tumuli. One on the hill, south of the river, is about sixty feet long, thirty wide, and six feet high. No excavations

have been made in this one, but a number of the smaller ones have been opened and bones and ashes found in nearly all. Mr. James Nipp kindly donated to the State Museum an ax, a flesher and a flint knife, that had been picked up by his son only a few days before. In section 17, Harrison Township, is a large circular mound of gravel that is usually considered as of artificial origin, and all the more remarkable, as it is surmounted by black prairie soil. It is, however, a natural mound, and is one of the kames that accompanies the moraine just north of it. A few skeletons were found in it, but this is true of nearly every gravel bank in the county, and indicates that the Indians used them as burial places. Dr. J. C. Ross, of Blountsville, has a fine collection of relics found in the county, including axes, pestles, knives, pipes, fleshers, shuttles, pendants, arrow-heads, tubes, hammers, and long round stones resembling a rolling pin. Mrs. Dr. Boor also has quite a collection of relics that were found in the vicinity of New Castle.

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